Space Weather Technical Forecast

Issued on Monday, 23 May 2022 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts through the forecast period.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low over the last 24 hours, with only C-class flares, mainly from AR3014 (Ekc/βγδ) and AR3017 (Eai/β) in the northwestern quadrant, which are the largest and most complex regions. Neither region has grown significantly within this period. The remaining six regions on the visible disc are all small and benign with limited development. Coronagraph imagery revealed a large prominence eruption on the northwest limb, although this appears to not be Earth-directed. No Earth-directed CMEs were observed in available imagery in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 has averaged around 520km/s due to the high speed stream from coronal hole 82. Density has been around or below average. Interplanetary magnetic field strength was weak between 4nT and 6nT, with the north-south component Bz varying between +5 and -5nT. Phi angle was mainly positive (away from the Sun) throughout. Total geomagnetic activity was Quiet.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) rose to moderate levels, peaking at 953 ppcc at 22/1615UTC. The corresponding electron fluence remained well below the Active threshold (1e8 integrated pfu) with a rising then level trend to reach 2.74e7 integrated pfu at 23/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be Low, although there is a chance of M-class flares, with the main risk for the two large regions in the northwest. Further active regions could also rotate onto the eastern hemisphere through the next four days.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected. Solar winds are expected to decline through the next three days due to a declining high speed stream. Further elevated winds are then likely on day 4, due to a further forecast high speed stream, estimated to reach 500km/s. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells through days 1 to 3. There is then a very slight chance of G1/Minor Storms on day 4, due to a potential connection with the high speed stream from coronal hole 85.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, with a slight chance of reach S1 levels. The high energy electron flux (greater than 2MeV) is expected to vary between mainly moderate and high levels on the diurnal cycle through the first three days. A sharp reduction is possible on day 4 (26 May) due to an increased geomagnetic activity. Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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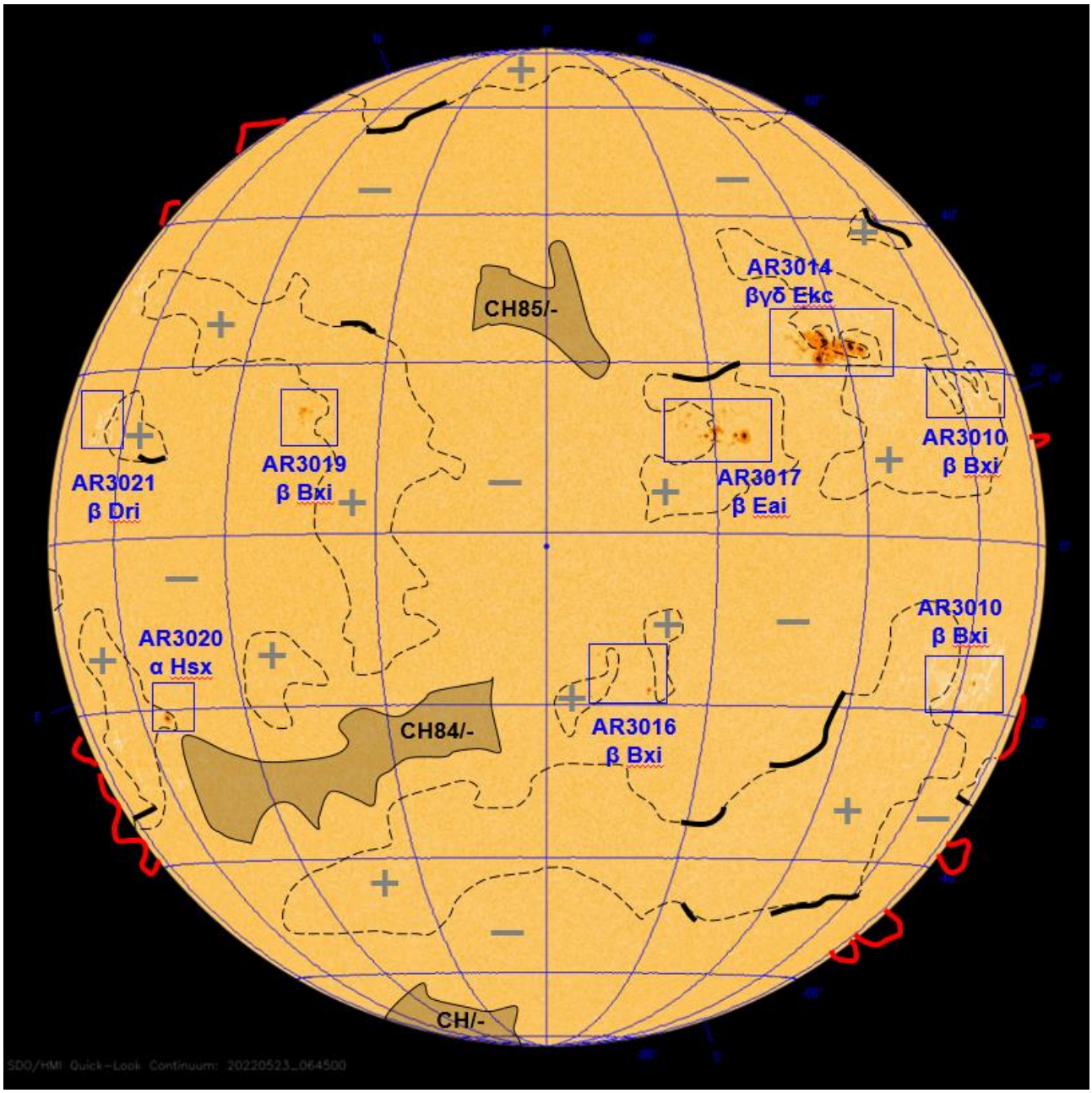
Figure 1. Solar Analysis Valid 23/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

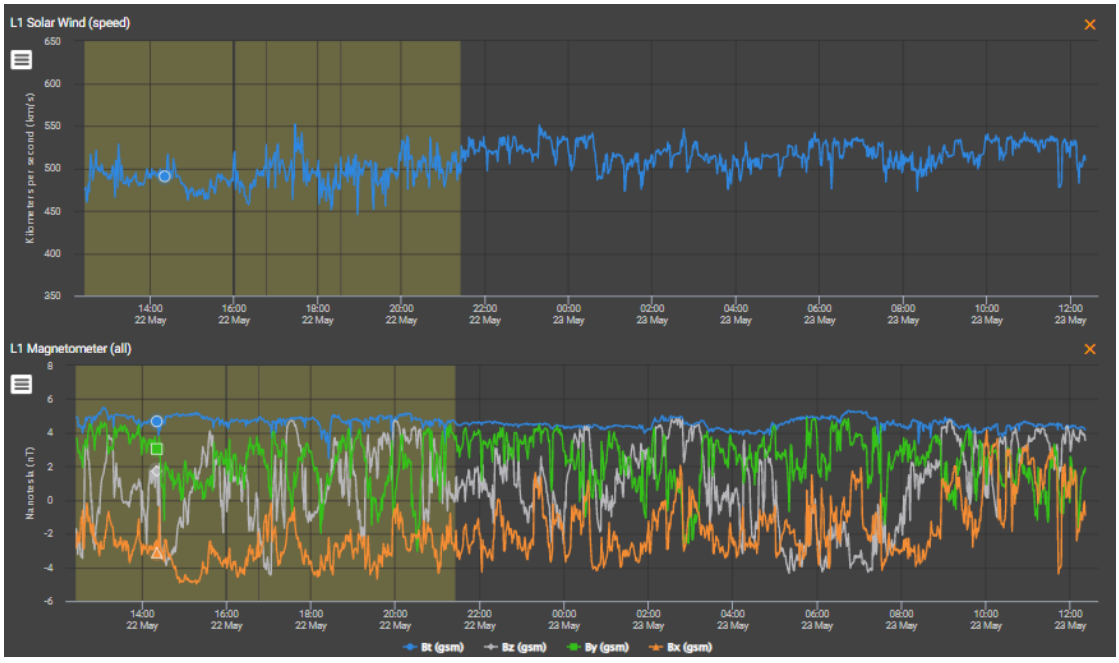
There are no CMEs forecast to arrive at earth in the next 4 days.

The high speed stream from coronal hole 82 is expected to ease on day 1 (23 May), gradually reaching background by day 2 (24 May). Coronal hole 85 is then expected to connect on day 4, with an estimated speed of 500km/s, although there is low confidence in this estimate as the coronal hole was not observed on STEREO A.

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells through days 1 to 3. There is then a very slight chance of G1/Minor Storms on day 4, due to a potential connection with the high speed stream from coronal hole 85.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: L1 solar wind speed and magnetic field



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Radio Blackouts - X-Ray Flares:
AR3014 (Ekc/βγδ) is the largest and most significant sunspot region on the visible disc. This region has not evolved much in the last 24 hours and has not produced much flare activity, with no M-class flares observed since 20 May. A few small simple sunspots have developed around the edge of the main sunspot, but none of these are considered to be a major risk. AR3017 (Eai/β) is also relatively complex but inactive, with limited development through the last 24 hours. The remaining regions are considered relatively benign and contribute little to the overall flare risk.

The stated flare risk is around half of that from what would be expected from the two large and complex regions on the disc, with significant reductions in risk due to the recent history.
There are a number of potential active regions due to rotate onto the solar disc during the next four days, indicated by bright flux areas on STEREO A EUVI imagery although no CMEs or significant flares have been observed from these regions.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: GOES 16 X-ray flare observations

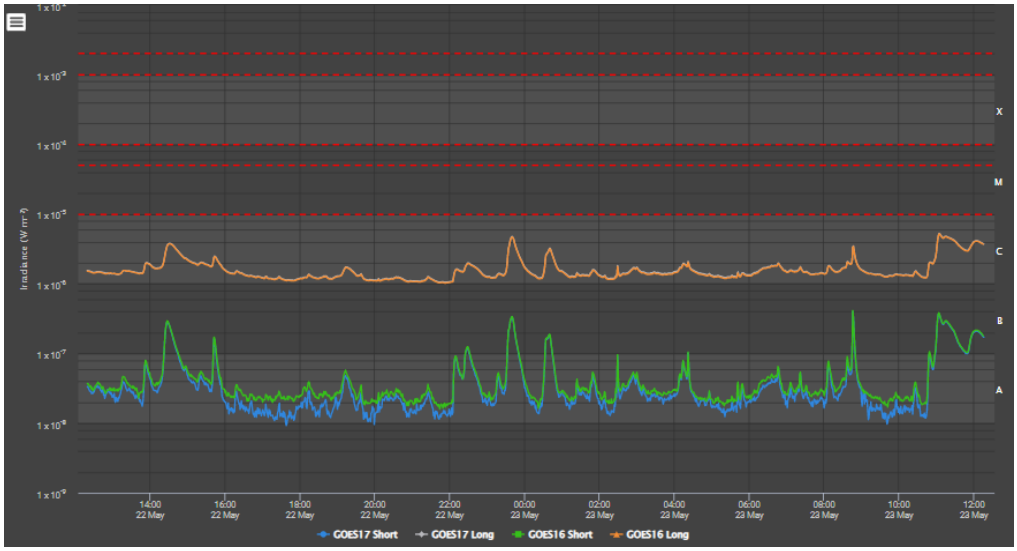

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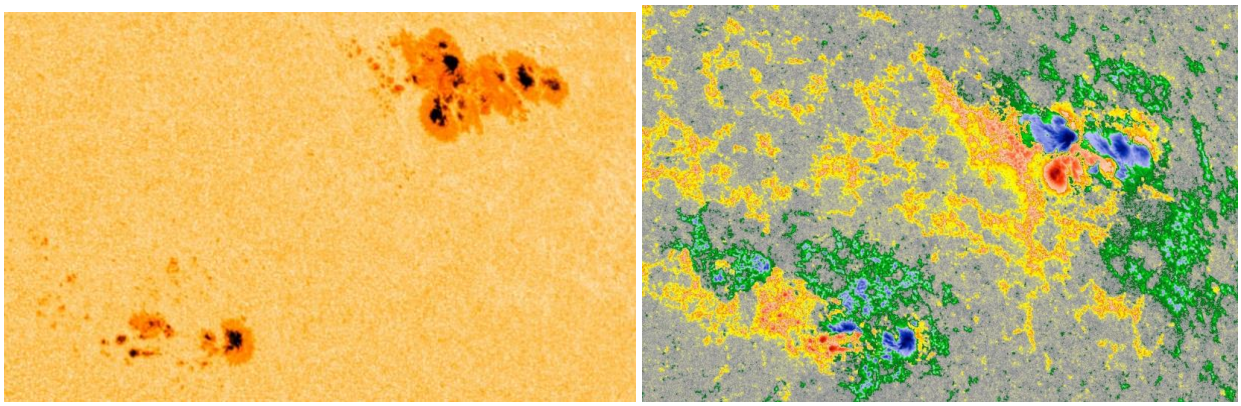
Figure 4: SDO HMI and SDO imagery of AR3017 (bottom left) and AR3014 (top right)



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period.

There is a slight increase in the risk of solar radiation storms through the next four days as regions AR3014 and AR3017 rotate towards the western limb, with this being the prime region for Earth-directed storms.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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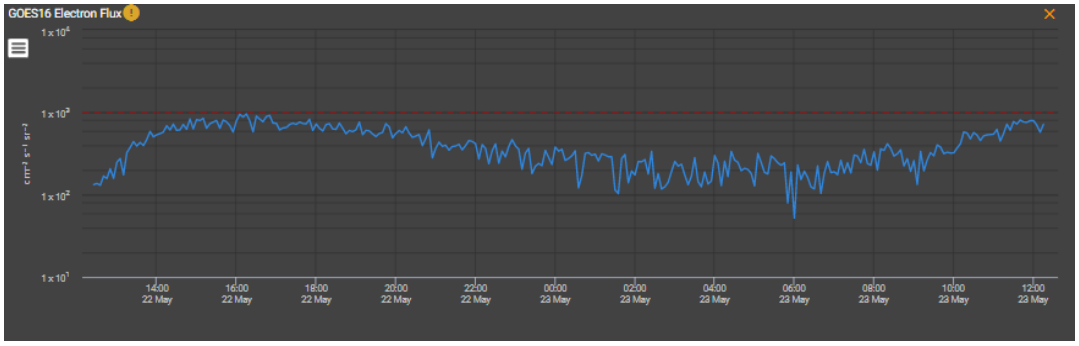
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) is expected to vary between moderate and high levels in the diurnal cycle through days 1 to 3, under the influence of the high speed stream from coronal hole 82. This is expected to wane through this period, with a steady reduction in the peak values. Potential geomagnetic storms due to the next forecast high speed stream may inhibit electron increases on day 4 (26 May).

Electron fluence is likely to follow a declining peak during the next four days due to the forecast decline in electron flux peaks.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	10	5	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES 16 electron flux and MOSWOC REFM model



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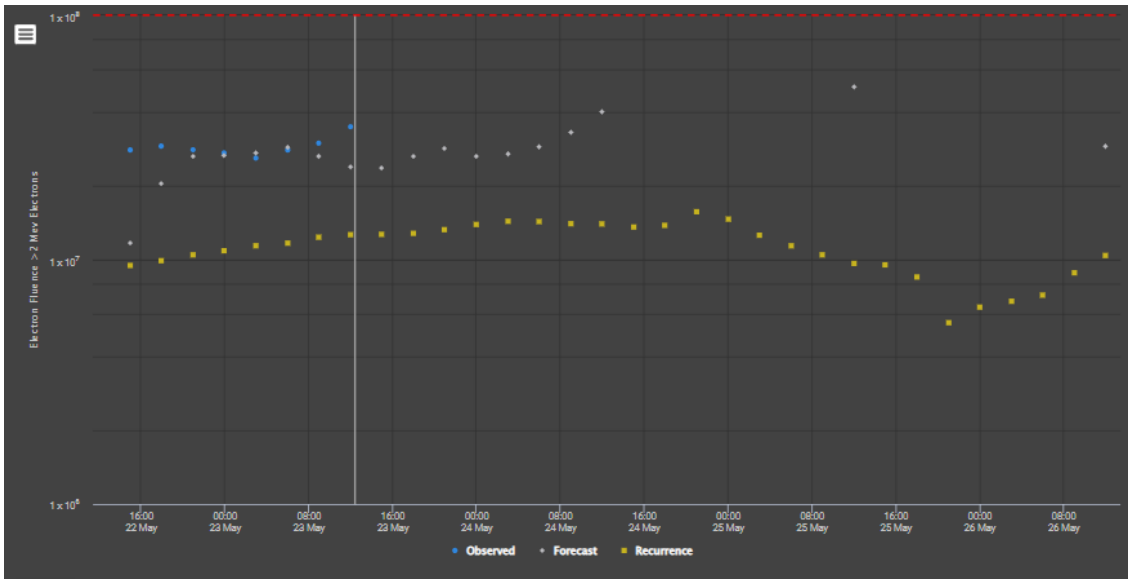

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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